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Underground Hangzhou: The challenge of safety vs. commerciality in a major Chinese city

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ABSTRACT

Underground space is extremely important for the compact and spatial intensive development of cities in the world. The gap of underground space between developing countries and developed countries comes from the immaturity of the market and institutional environment, which leads to an urgent demand for new urban governance theories to guide practice. Governments often pay attention to safety, while the market is business-oriented and focuses on commercial value which leads to a trade-off between them. This paper explores the safety and commerciality from the viewpoint of urban governance theory, and uses case studies of three underground space projects in Hangzhou, China, finds that the logic behind safety and commerciality choices is actually the logical relationship between the government and the market. It is concluded that a logical conversion from complete government-led to market-oriented and government-assisted is needed to resolve the imbalance between safety and commerciality. This paper criticizes the shortcomings of traditional planning theories on urban governance and subject research, incorporates the system and time dimensions into the framework of urban governance theory, and proposes a multiple governance mechanism which can integrate safety and commerciality as a means of maximizing socio-economic benefits.

1. Introduction

Urban underground space (UUS) is extremely important for the compact and spatial intensive development of cities in the world. However, there is a major gap between the developing and developed countries in the planning and development of UUS. China's urbanization has rapidly increased the demand for underground space development. The Chinese government has selected Hangzhou as a pilot city, which also has significance for other developing countries.

UUS is defined as the space below the ground that is developed, constructed, and used to meet the needs of human society in production, living, transportation, environmental protection, energy, safety and disaster prevention. It contains huge and abundant space resources, which have gradually become an effective means of improving urban capacity, easing urban traffic and improving the urban environment (Zhang et al., 2017). UUS is also an important part of the local economy in China. Considering the value of providing earthquake and disaster reduction services, UUS can contribute over 5% and 8% of GDP respectively (Qiao et al., 2017). Hangzhou has been designated by the Chinese central government as a pilot city for the development and utilization of UUS and will be the focus of this study.

More utilities are placed underground, increasing the density of overall utilities (Hunt et al., 2011). UUS has the potential to relieve surface pressure, provide additional space for public transport networks, reduce noise and improve air quality, maintain more green areas in the central city, and improve the urban environment through better concentration of functions, thus reducing infrastructure costs (Durmisevic & Sariyildiz, 2001). UUS also has great commercial value. The rail transit business has a very obvious market exclusivity, since rail transit stations contain huge and stable passenger flows. On the other hand, the commercial development of rail transit is subject to more restrictions, such as rail transit operation regulations, which may constrain UUS construction technology in the interests of safety (Li et al., 2014).

Although UUS has great commercial value, there are many hidden

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dangers in its development and utilization. An important indicator of UUS safety is disaster prevention performance with regard to fires, explosions, earthquakes and floods (Peng et al., 2010). The environment of UUS is more complicated, and disaster prevention becomes more difficult (Jiang et al., 2015).

The safety and commerciality of UUS are sometimes in conflict. Because of the limitation of geological and ecological conditions, safety will potentially limit the boundaries and development volume of UUS, and thus limit the commercial scale. Taking the long-term view, the Chinese government gives highest priority to safety. In contrast, the market-oriented developers often ignore the safety and safety restrictions for short-term interests. Due to the special structure of UUS, a high degree of safety means extremely high costs, which are not conducive to commerciality. Thus, in practice, there is conflict between the two elements.

The primary factor affecting the Chinese policies is the special endowment of land space resources. China has a population of 1.4 billion, a large population and a small amount of land. The protection of arable land has led to scarcity of urban space resources. Therefore, the government wishes to increase the development of underground space to increase space resources. And local governments have become the dominant force in the development of UUS. Compared with developed regions, China started reforming in 1978 and moved toward a market-oriented economy in 1992. As a developing country, its market environment and political system are still immature. Although the central government has promoted the decentralization of power to the market through policy support, in practice, there are still problems of excessive government power and intervention, which also has an impact on the safety and commerciality balance.

Excessive government power, policy constraints, and the lack of market participation in the preliminary planning will cause problems such as unitary functions, excessive emphasis on safety, and neglect of commercial benefits. There is an urgent need for a new governance mechanism to clarify the logical relationship between the government and the market, and formulate new policies to integrate the safety and commercial segmentation of underground space. How to optimize the mechanism between safety and commerciality under the logical relationship between the government and the market is the research problem studied in this paper. The research aim is to explore the integration of commerciality and safety to improve socio-economic benefits. Sections 1 and 2 review the existing theories on safety and commerciality, government and market. Section 3 introduces the research design; collects data through case studies and interviews; and uses grounded theory to present a preliminary hypothesis. Section 4 discusses and analyzes three Hangzhou cases combined with certain relevant international cases. Section 5 builds a complete conceptual model and mechanism. Section 6 is a summary including recommendations, and the areas that need further research.

2. Literature review

The theoretical development of UUS is less developed than that for above-ground-level developments (Zhu & Song, 2015). Most research studies on UUS view it in terms of technical engineering and technical economics. Few researchers analyze the safety and commerciality from the perspective of New Public Management. Lin (2018) put forward the concept of *efficient market and promising government*, and pointed out that government and market play different roles at different levels of development. In fact, the safety and commerciality of UUS is not a zero-sum game, and there are better choices under the role of government and market.

2.1. Safety and commerciality of UUS

Urban land utilization change is a dynamic system composed of five subsystems: urbanization, social, economic, environmental and land use subsystems (Wu et al., 2011). Effective utilization of UUS to enhance socio-economic benefits requires a more systematic approach to design and evaluation. The value of UUS is first related to its surface economic environment (land price, density, accessibility, livability and affordability of users). It is also related to the peculiar underground elements, such as building costs, skills and materials (Li, Li, et al., 2013). The common feature of all these aspects is that at the planning stage they are very subjective, and the question is how to provide objective measurements. Commerciality and safety are two of the most important aspects.

2.1.1. Commerciality of UUS

Since UUS itself is not a separate commodity with a clear existing market, its market value is usually not observed and must be estimated (Pasqual & Riera, 2005). An important element of UUS business value is passenger flow, which directly determines the basis of commercial benefits. The success of Hong Kong MTR is inseparable from its combined property development model. The passenger flow brought by rail transit has promoted the development of real estate, as well as the formation of a comprehensive development area around the site, including businesses, offices, residences, education, culture and entertainment (Gao & Cao, 2010). At the same time, the continuity of UUS is related to the amount of passenger traffic and directly affects the expansion of commercial operations (Li, Zhang, & Han, 2013).

The developer of Montreal Underground City in Canada connected the office building with the central station through an underground pedestrian tunnel, and arranged commercial shops along the pedestrian tunnel. The original system relied on two functions: transportation and commerce (Hu & Zhao, 2007). This shows that a reasonable layout, convenient and fast accessibility are important factors of UUS to attract traffic and generate economic benefits. The passenger flow through underground commercial space needs to be considered carefully, especially its linkages to other such facilities. Because UUS has insufficient natural light, it is isolated from the outdoor environment, hence accessibility has become one of the key points for success or failure. For underground commerce, the more convenient it is, the greater the commercial passenger flow.

2.1.2. Safety of UUS

In China, most areas are fortified against earthquakes as half of the cities are located in earthquake areas. Therefore, it is extremely important to ensure safety in the designing of underground structures (Yuan & Chen, 2014). For UUS safety evaluation, not only should the quantitative indicators, such as space, temperature and humidity, be considered, it is also necessary to consider the lack of natural light and poor air circulation, there will be an impact on human physiology and psychology. Due to cognitive limitations, developers often ignore these psychological factors. It is even difficult for researchers to quantitatively analyze these factors, and they may form a hidden safety hazard (Jiang et al., 2015). The threat of such safety issues is illustrated by Kaohsiung Underground Street in Taiwan, where a fire was caused by poor maintenance and the underground street was subsequently abandoned (Liu, 2006).

Safety restrictions on UUS are also becoming more apparent. In high-density urban areas, competition for physical space is fierce, and existing structures may hinder further development of UUS. Larger UUS developments may also jeopardize the stability of geological underground water tables, including changing groundwater flow (reducing flow and flow rates) and contaminating groundwater. New construction activities and water withdrawal will change soil stress conditions (Bobylev, 2009). With the advancement of ventilation and excavation technology, larger tunnels have appeared and the possibility of disaster risks has increased accordingly (Peng et al., 2010).

2.1.3. Unity and exclusion between safety and commerciality

The safety and commerciality of UUS are both uniform and constrained. On the one hand, the environment of UUS is different from

general building, and these environmental deficiencies have been noted. There is likely to be an impact on human physiological comfort. The quality and safety of the internal environment directly affect the subjective evaluation and ultimately affect the value of UUS (Li et al., 2014). The ultimate purpose of safety and commerciality is to enhance socio-economic benefits, which is the embodiment of the unity.

On the other hand, safety and commerciality can be seen to be in conflict. To ensure the high safety of underground space projects, it is necessary to spend more on high safety construction, monitoring and maintenance costs, which will affect the commercial viability of the project. Developers pursuing short-term benefits to save costs in order to improve economic efficiency are tempted to make cuts on safety. Yet for UUS projects of quasi-public goods, the purpose of such UUS is not to make profits, but to provide public services for all citizens. In China, this type of UUS (such as the subway) cannot be fully privatized, because as rational economic individuals, private enterprises may reduce the expenditure on safety to reduce the total cost in order to maximize profits, thereby causing potential safety risks (Zhang et al., 2017).

2.2. Insufficiency of urban governance research in traditional planning theory

The ideological core of planning theory should be the development and utilization of urban underground space to make people's travel more convenient and the urban ground environment better (Hou & Liu, 2005). Urban planning and development must adhere to humanism and put the concern for people in the first place. It is required that various facilities that are closely related to people's daily life must be compactly arranged in a suitable spatial scale to be convenient for people to use (Dai & He, 2014). Urban complex system theory believes that traditional urban planning theories form urban functional zoning based on the convenience of management, dismembering the organic composition of urban space, causing unreasonable urban spatial structure and huge waste, and directly affecting the overall function of the city (Qiu, 2009). The objective of urban governance is to achieve reasonable compactness, efficient and intensive space and the integrity of the city. This is exactly the direction of the future development of underground space in developing countries represented by China.

Urban governance can be summarized as the treatment of different forms of urban issues by multiple entities through governance, such as the density, agglomeration and intercommunication. However, traditional theoretical research on planning is mostly at the level of physical space and has not entered into entities, especially the lack of research on the interaction of governance subjects such as government, market, and society. Urban planning is a government action. The government action has gradually changed from independent government control to government guidance, mobilizing the enthusiasm of urban subjects. The market can promote economic development, but it cannot solve the problem of environmental protection; the market can bring about economic prosperity and the expansion of urban areas, but it also causes the suburbanization of cities and the decline of urban centers. These problems must be resolved by the government to make up for the defects of the market in time, and the government must rely on the enthusiasm of the real owners of the city—social organizations and enterprises (Qiu, 2004). An open, transparent and comprehensive partnership between business, government, and society can power the economic transformation (Rifkin, 2012); Rifkin also proposed that the internal mechanism that powers economic transformation between government, business, and society is a diversified mechanism.

A powerful government that disregards the interests of the people is out of control and needs to draw the boundaries of government capacity. Every generation tries to redefine the boundaries that separate politics from civil society and the market. The functions that were originally assigned to politics have been privatized and deregulated, and have been reintegrated into civil society or the market (Fukuyama, 2002). China has its own historical environment. For such a centralized country, its political tradition has always been that the government power is excessive. The government monopolizes power, the power of local government is highly concentrated, and the market is influenced by policies, forming a centralized administrative system. China's land system is characterized by a combination of state ownership and collective ownership. However, collective land is basically controlled by the state and cannot be transferred to the land market unless it is requisitioned and acquired by the government (Shan et al., 2017). In China, the boundary between the government and the market has not been fully determined, friction and conflicts have occurred from time to time, but the new understanding is that the government and the market can work together and support each other in an economy (Zhou, 2017).

2.3. Research gap: research on urban governance of government, market, and society in UUS

Traditional planning theories are short of research on the role of subjects such as government, market and their impact on underground space. There are gaps in the logic of government and market behavior, and their impact on the safety and commerciality of underground space, which is inappropriate to guide the practice. This paper will also combine three cases in Hangzhou with Hong Kong MTR, Montreal Underground City and Kaohsiung Underground Street for comparative analysis to explore coordinating this logical relationship to integrated safety and commerciality.

3. Methodology

3.1. Research methods and design

The research methods used in this paper are grounded theory and case studies. Grounded theory is a system-based theory obtained through “social” research and based on data (Goulding, 2013). The case study is an attempt to gain an understanding of processes and phenomena that exist within a single, possibly unique situation (Choguill, 1998). Grounded theory and case studies are both methods of qualitative research, to describe the process of meaning formation (rather than the result), and to describe how people explain their experiences (Babchuk, 2017). Glaser and Strauss (1968) believe that the most reasonable way to form a theory is to “root” it into the data being studied, and that theory is part of the data. The process of constructing a theory is actually part of the data collection process. The focus of grounded theory lies in the formation of the theory, which should be seen as an organism that can adapt to new data and environmental changes.

The strengths of case studies are that they can have more sources of data: file archives, physical evidence, interviews, and observations (Yin, 2010). There are three reasons for choosing three cases in Hangzhou as research objects. First, Hangzhou is a pilot city for UUS in China, and is at the forefront of UUS exploration. Second, these projects have their typical representativeness, they are the star projects that have attracted much attention throughout the country. Third, the views of managers from developing countries can be explored in depth, providing Chinese experience, and enriching existing research literature in developed countries. The detailed overall research design is shown in Fig. 1.

3.2. Data collection

Researchers visited the project sites and discussed the research issues with project managers. Semi-structured interviews and in-depth interviews were used. The interviewers had been trained to understand the main elements of the topic. The topic of the interview was the role of government and market in the planning and development of UUS, and their safety and commercial impact. The method of data collection was to conduct field surveys on three projects in Hangzhou. The observations took place over 6 months. The researchers observed the projects from June to December 2019 (Tables 3, 4 and 5). During this period, field

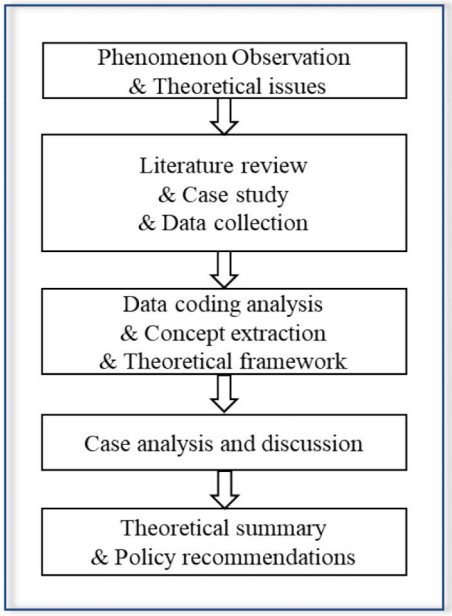

Fig. 1. Flow chart of research design.

observations, interview transcripts and photographs were obtained. The researchers conducted 4 field interviews, 3 symposia and 6 telephone interviews. The interviewees were the project managers of government and developers. Therefore, the interview records are the primary data used in this research. The interview dates and details of the interviewees are shown in Table 1.

3.3. Data analysis: coding

The analysis procedure of grounded theory is coding. In qualitative data analysis, coding is a structure generated by the researcher. Each individual datum can be symbolized, and the interpreted meaning can be assigned to attributes for later pattern detection, classification, theory building and other analysis processes (Saldaña, 2012).

In the first stage, the paper conducts a definition and preliminary conceptualization of all textual materials, breaking up the original materials, giving concepts, and recombining them in a new way (conceptualization). The concepts are named by borrowing the concepts from the existing literature, or using the original words of interviewees. After getting some concepts, we classify different types of concepts under a higher level of abstraction according to their attributes to form categories, and define the nature and dimension of the category (Table 2).

In the second stage, associative coding is used to clarify the concepts and their interrelationships. By analyzing the relationships between concepts, the interrelationships between concept categories are identified. After a gradual analysis of each conceptual category, a relationship network is finally formed. In the analysis, the categories that are most relevant to the research problem are selected to analyze the relationship between the categories and sub-categories. The government controls safety through safety supervision, planning guidance, and policy. Market controls commerciality through public-private cooperation, independent operation and private capital.

Table 1
Key information related to the interview.

Date	Designator	Interviewee details
2019/6–2019/11	Government representatives A, B, C, D	They have been in charge of the Hangzhou Planning and Natural Resources Bureau for more than 5 years, responsible for the planning and approval of UUS projects.
2019/09–2019/11	Manager A (Developer)	Project manager of Future Sky City, responsible for on-site management in two projects for more than 7 years
2019/09–2019/11	Manager B (Developer)	Manager of European and American financial city, engaged in UUS management for more than 6 years
2019/11	Representative A (Metro Property Company)	Chairman of Hangzhou Metro Real Estate Company for more than 10 years

3.4. Preliminary conceptual framework: institutional and time dimension

Based on surveys and data analysis, it is found that projects in different types and different environments are located in different dimensions. UUS in China is basically a government-led model, and the government has greater control over safety through institutional forces. Enterprises pursue short-term benefits, the high cost of UUS safety protection determines that it is difficult for enterprises to control safety through market forces, but the pursuit of economic benefits determines that the market's influence on commerciality far exceeds the government. Therefore, the government-led dimension is for the government to fully allocate resources and supervise safety. The market-led dimension is for the market to allocate resources spontaneously and focus on the utilization of commercial resources. One can then propose an *institutional dimension*, as shown in Fig. 2. The *institutional dimension* is based on the degree to which the project is controlled by the government. It is divided into a pole completely allocated by the government and a pole which market-oriented and government-assisted. The degree of government control is difficult to measure quantitatively, therefore, this research uses qualitative analysis. Complete government allocating is a way to allocate resources according to the will of the government. It is possible to focus more on complete safety in pursuit of political stability. The market-oriented and government-assisted pole is to play a role in market competition and incentive mechanisms to effectively allocate resources, at the same time utilize appropriate government to solve problems such as coordination and safety supervision.

Based on observations, the researchers also propose the concept of *time dimension* according to the time point (early or late stage) when the project starts safety intervention. One can also see that the different timing interventions of *pre-planning intervention* and *later activation* have opposite effects (such as early seismic design or structural protection). The *time dimension* and *institutional dimension* formed the preliminary conceptual framework of the research. In this framework, each quadrant has different attributes and characteristics. Cases considered here can be assigned to different quadrants based on the property (details given in case studies).

4. Case studies of institutional and time dimension

Hangzhou is a highly developed modern city with long cultural history. It is a national strategic city with a population of more than 10 million and serves as the provincial capital of Zhejiang Province. Hangzhou established a leading group to coordinate the development of UUS, and promoted UUS through the overall development of new urban areas, improved connectivity, and expansion of subway stations. The Hangzhou government has utilized the construction of a subway line network to promote UUS and build an underground city. By 2020, the development and utilization area of UUS will reach 100 million square meters. The Future Technology City (to the west of West Lake), an area which includes the headquarters of the internet firm Alibaba, has gradually developed into a sub-center based on the development of UUS in west Hangzhou. The Future Technology City is also the location of the two cases investigated in this paper (European and American Financial City, Future Sky City). In the early 2000s, UUS in Hangzhou initially developed eastward, where another case (Seven Fort Complex) investigated, is located (Fig. 3).

Table 2
Initial conceptualization and categorization.

Categories	Socio-economic benefits	Government	Market	Safety	Commerciality
Concepts	Commercial value Costs and benefits Social benefits	Government-led planning Property management Safety supervision	Private capital Public-private partnership Autonomous operation	Technical security Geological safety Disaster prevention	Passenger flow Interconnection Traffic accessibility Business environment

Table 3
Objectives of the European and American Financial City.

Participants	Proportion of property ownership area	Characteristics
Government: Management Committee of Future Technology City	/	Their main responsibilities are to provide overall regional planning, transfer land. The purpose of government officials is to carry out city development and construction in an orderly manner under the premise of ensuring safety.
Zhejiang Construction Engineering Real Estate Development Group Co., Ltd.	30/110	They are committed to building metro housing, office buildings, hotels, international apartments and large commercial centers.
Customers	80/110	Safety, and high-quality services are their basic requirements.

Table 4
Objectives of Future Sky City.

Participants	Property rights	Characteristics
Government: Management Committee of Hangzhou Future Science and Technology City	/	Because it involves subway development, the primary responsibility of government is to ensure safety first, economic indicators later.
Hangzhou Metro Company	Underground/ subway exit	Future Sky City is a property project on the subway. The development of the underground space is completed by the subway company and then transferred to the developer to develop the above-ground components.
Hangzhou Vanke Real Estate Development Co., Ltd.	Above-ground building	The developer is mainly responsible for commercial and residential development above the ground, but also the access to the subway station and the connection of the underground passage.

4.1. Case 1: European and American Financial City

The European and American Financial City is located in Hangzhou's Future Technology City. In 2015, the government constructed an overall plan for the Future Technology City, and an underground metro line loop was included. The European and American Financial City was originally a company focusing on surface development, but under the effect of policy incentives, it also developed underground space, and invested in a construction to connect with the underground loop, which was officially put into use in September 2019. The European and American Financial City has achieved great success in both the *time dimension* and *institutional dimension*. This is mainly due to appropriate government support and incentive effect of market mechanisms, as well as the pre-planning for safety and commerciality.

Table 5
Objectives of Seven Fort Complex.

Participants	Investment proportion		Characteristics
Government department	/		Responsible for planning and guiding the preliminary work, also prioritizing safety, and coordinating various stakeholders.
Hangzhou Metro Real Estate Co., Ltd.	49%		Responsible for the subway construction of the underground part.
Hangzhou Greentown Group	51%	A/51%	Responsible for commercial development of the above ground components.
Ping An Group		(51-A/ 51)%	Ping An Group was originally an insurance financial company, and was introduced by the real estate company Greentown to play the role of financial investor.
Customers and users	/		Metro tourists and users constitute the main traffic flow and consumers.

4.1.1. Success in pre-planning: communication and collaboration

UUS should be fully considered in the preliminary master plan of cities (Bobylev, 2009). The government and the market have fully communicated and coordinated in pre-planning, effectively avoided the municipal pipe network, solved potential safety hazards, and pre-reserved channels to connect to the underground loop. Therefore, the preliminary planning fully considered safety and commercial value. On the one hand, it reserved the interconnecting channels for designing, laying a solid foundation for achieving high passenger flow and a highly developed transportation system in the future. At the same time, the respective potential safety hazards were eliminated, and the interconnections was successfully realized in subsequent construction.

4.1.2. Decentralization and effective market-based incentives

The government delegated power to the market and adopted successful measures of marketization and property rights protection to motivate enterprises. The government publicly supported the developer to independently hold 0.3 million m^2 (0.3/1.1, a total of 1.1 million m^2) area, including commercial and official buildings. Although the initial investment is large and the cost is high, the developer owns nearly one-third of the building area and sees hope for operating income. The developer connected the Central Park Station of Line 5 on the southwest side with the underground commercial space, invested in the construction of a corridor system on the ground level, and linked with passages of the underground development (Fig. 4). They hope that these measures will increase transportation convenience and bring more business benefits. Coincidentally, these measures have also inadvertently improved safety.

The research survey found that this measure has stimulated the investment enthusiasm of market entities and inspired them to innovate. It was found that the passenger traffic has increased significantly compared to the previous period, and more business entities and companies have come in. It can be seen that encouraging developers to hold a certain percentage of their property rights, stimulate their profit-seeking motive of self-innovation can enhance the motivation for improving traffic accessibility, internal safety and comfort, and attracting more businesses. The effect is obvious in that Alibaba has

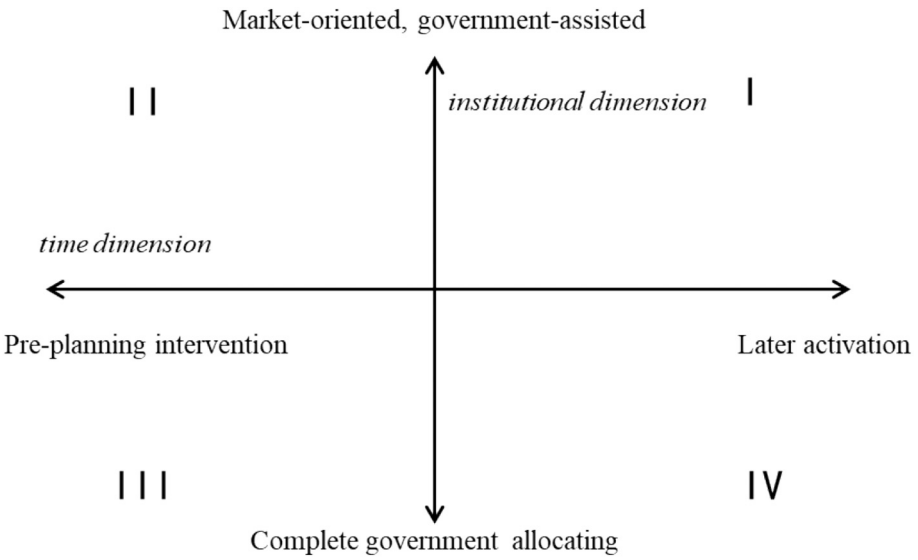

Fig. 2. Preliminary conceptual framework (Time dimension and Institutional dimension).

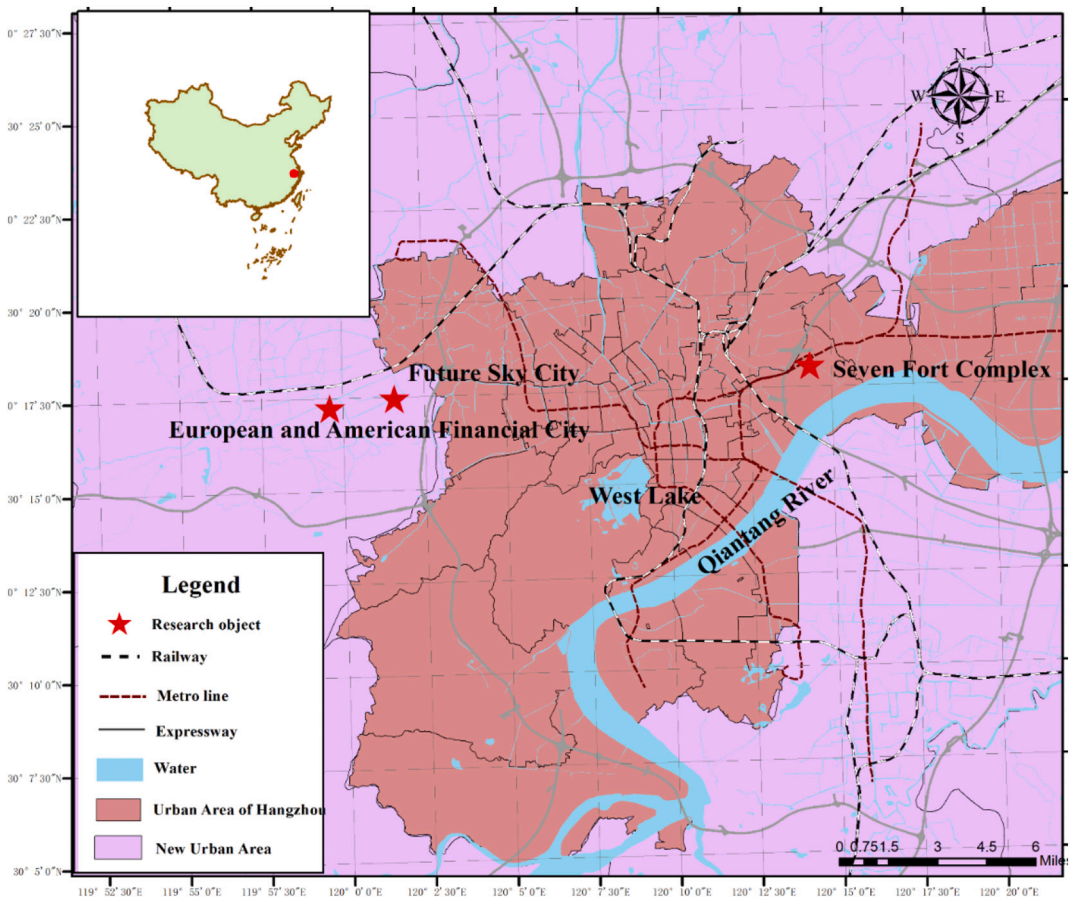

Fig. 3. Location of UUS projects in case study (Hangzhou).

officially signed a contract to enter the European and American Financial City.

'300,000 of 1.1 million m^2 are held by ourselves, although the government does not subsidize it, we have the incentive to invest in our own possession. Property rights have a strong appeal to developers. Moreover, the maintenance cost of underground space is also higher. It is necessary to activate its commercial value through property rights. We have invested to establish corridors between commercial buildings to strengthen connectivity and improve traffic flow. We also spend more money to maintain safety and the environment.'

—Manager of European and American financial city company.

Fig. 4. Improved traffic accessibility and safety comfort inside the underground space.

4.1.3. Government decentralization and marketization: Hong Kong MTR

The success of Hong Kong MTR is derived from the government decentralization and marketization dominance, which stimulates commercial vitality. Hong Kong MTR has performed well in its preliminary planning and market commerce. The development is characterized by the orbital station and a comprehensive developing of superstructures, stations and surroundings (Gao & Cao, 2010). The characteristics of Hong Kong MTR including two aspects: (1) The government delegates management power, and subway developers have full management power to attract outstanding merchants as much as possible to make shopping malls flourish. The commercial location of the space is clear, and the market analysis is quite thorough. The theme of the property on the subway is clear. It is usually divided into three parts: retail, catering and entertainment, and the distribution is reasonable. (2) The design and planning of Hong Kong MTR commercial space is advanced, with global and forward thinking, modern hardware, and humanized software. Moreover, the safety design is the first priority. When planning an underground commercial space, the planner must not only design the escape route, safety facilities and ventilation equipment, but also bring customers a double sense of spaciousness and comfort in both visual and spiritual (Zhang & Liu, 2010).

4.2. Case 2: Future Sky City

Future Sky City is located to the east of Future Technology City, at the exit of Wuchang subway station. In July 2018, Hangzhou Metro won the Wuchang Metro Complex bidding. In October 2018, Hangzhou Metro and Vanke Hangzhou confirmed the cooperation on the development of the project. The Hangzhou Metro is responsible for the construction of the subway part and Vanke Hangzhou is responsible for the superstructure. It is connected to the underground space from the exit of Wuchang Station of Metro Line 5. Hangzhou Metro is a state-owned company, and the government attached great importance to the project. Therefore, Future Sky City is a government-led project.

4.2.1. Lack of market power and commercial value in pre-planning

At the academic and practitioner level, the value of underground land often seems to be missing and is a hidden factor in land economics and planning (Pasqual & Riera, 2005). Future Sky City also appears to have made this mistake. The government, which plays a leading role in the project, attaches great importance to safety, but ignores commerciality. Back in May 2015, the government and the Metro Group were involved in the safety planning at the initial stage, but at that time, the development company responsible for developments above ground had not been introduced, as a result, market forces were missing in the early planning stage. It was not until October 2018 that the development company Vanke Hangzhou confirmed its cooperation with Hangzhou Metro and entered the project. Unfortunately, the preliminary planning did not give sufficient consideration to the overall value of the superstructure property, resulting in the location of the exit at the eastern edge of the project. This position is far from the commercial axis (0.5 km away), which is not conducive to the commercial value. There is a long distance from the west side to the exit (Fig. 5). After exiting the station, the west side of the area cannot be quickly reached and the traffic accessibility is greatly affected. From Fig. 5, it can be seen that placing the subway exit on the commercial axis of the entire area is the most conducive to maximizing commercial benefits. In pre-planning, both safety and commerciality should have been considered under the premise of ensuring safety.

> 'The government, including ourselves, is undoubtedly focused on safety considerations. Our primary principles for underground development are safety, safety assessment and monitoring. The cost of safety monitoring can reach millions each year. But putting this exit in the Eastern District instead of the Central District will result in hundreds of millions of losses.'
>
> —Project manager of Future Sky City

4.2.2. Government intervention and market failure

Difficult choices are often involved in economics to allocate scarce resources with multiple uses (Thomas, 2018). Changing the location of the exit is technically a high risk, and the government rejected the plan. This is actually a trade-off of rational allocation of limited resources (space and funds) in terms of safety and commerciality. The location of the exit from the commercial center axis negatively affects the enthusiasm of the market units. The remaining underground passages must be borne by the development entities themselves, which not only increased the cost burden. But also affected the traffic accessibility, pedestrian flow, and commercial value. This shows that government-led and early planning interventions may have strong control over safety, but not enough to ensure commerciality. The reason why local governments attach importance to safety involves the consideration of political interests by politicians. But it is clear that excessive government intervention in safety will directly affect the promotion of commerciality, both in planning and implementation. The government can only intervene moderately, focusing on supervision rather than regulation, allowing market mechanisms to function, and ensuring safety and commercial compatibility.

4.3. Case 3: Seven Fort Complex

Seven Fort Complex is located in the eastern part of Hangzhou, by the Qiantang River. In October 2014, the land parcel of Seven Fort Complex was acquired by Hangzhou Metro Group (representing the government) and Greentown Group for a total price of 623.6 million USD. Seven Fort Complex is a subway superstructure, which introduces outstanding commercial development opportunities and provides a variety of commercial formats. It can be called a typical multi-participation project in Hangzhou. The safety construction in the early stage is as yet incomplete, but the government has no excessive restrictions on this project.

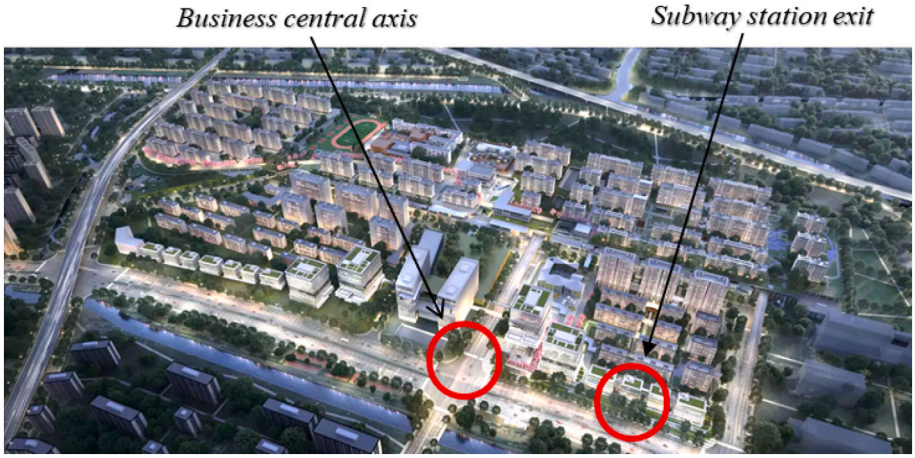

Fig. 5. The exit away from the central axis makes a negative impact on overall benefits.

Therefore, the developer has a chance to introduce financing companies to alleviate the pressure on funding, and the investment of funding has gradually improved safety issues.

4.3.1. *Lack of safety in pre-planning*

Contrary to Future Sky City, government did not attach importance to safety at the early stage. There was also no effective supervision in planning and design. Due to insufficient safety intervention, consideration and design; the project experienced an extremely difficult phase. The safety review of the project failed repeatedly, and as a result, accidents almost occurred in the subsequent construction process. Such as the conflict with the municipal pipeline, because there was no coordination with the municipal department in the previous planning, there was a great safety threat during the construction The authors thought that the safety investment saved in the previous period saved costs. Instead, in the later period, they had to invest more money to improve safety. It can also be seen that government intervention and supervision are still necessary, but a moderate balance is needed to ensure compatibility between safety and commerciality.

4.3.2. *The effect of marketization: multi-unit participation and later safety activation*

The subsequent market diversification financing improved the situation. The source of funds was self-raised by shareholders of both parties in accordance with the shareholding ratio. Hangzhou Metro Group accounted for 49% of the shares, and Greentown Group accounted for 51%. Later, Ping An Group was introduced to play the role of financial investor. Hangzhou Metro Group is responsible for land acquisition, Greentown Group is a noted developer, and Ping An, which has strong financial strength, is responsible for financing. The investment cost in the early stages is large and the investment cycle is long. The developer bears extremely high risks. Since Ping An is responsible for financing, it reduces the financial risk of the developer. The participation of multiple entities reduces the funding pressure allowing the participants to invest in safety construction and daily maintenance. In the subsequent safety review, the safety was evaluated as being gradually improved, and the project was finally successfully completed and opened to the public. This demonstrates that the combination of government and market force participants can improve a weak safety situation. However, this process is accompanied by high risks, and more costs have been invested.

4.3.3. *The government delegates power to the market: Montreal Underground City and Kaohsiung Underground Street*

There are also cases where the role of governments was lacking and pre-planning did not take into account safety and commerciality. Montreal Underground City and Kaohsiung Underground Street, both of which have made use of market forces to make up for the safety issues, but the results are quite different. This research compares them with the Hangzhou cases and a lesson can be learned from them.

In Canada, the administrative functions of the government are relatively weak; land is privately owned and government-controlled land is relatively small. The preliminary planning and design was not systematic. However, Montreal Underground City was introduced as a private enterprise participation model that makes full use of the natural flow of people to create an active UUS. Montreal Underground City could not have been achieved without the participation of private finance. Private developers invested capital for the construction, maintenance, supervision and liability insurance of passages, tracks and buildings. City participation is achieved in the form of concessions. Finally, Montreal Underground City introduced business ideas, fully exploited the commercial value of UUS, actively introduced commerce, encouraged investment and development, attracted larger consumer groups, and increased the economic value (Hu & Zhao, 2007).

But not all similar projects are successful. Kaohsiung Underground Street in Taiwan lacked early planning interventions and business strategies. The catering industry was mixed with other activities and the use of open fires in the kitchens was unrestricted. This resulted in a deterioration of the underground street and a lack of fire protection. In order to attract private investment, the government signed a contract with the developer and stipulated that after completion, the developer was the legal manager of the underground street. There was, however, no restriction on the transfer of property rights in the contract. Therefore, the developer sold over 85% of the ownership to the stores in private transactions, resulting in constant disputes between developers, government departments and the stores. In 1988, due to poor maintenance, a fire broke out. Kaohsiung Underground Street eventually had to be filled in to create a park (Liu, 2006).

It can be seen that the lack of safety planning at the early stages can have a significant impact on safety risks. The supervision of government in early planning has a significant impact on safety, and market forces make up for the lack of government but are limited in terms of safety, both government and market forces are crucial.

4.4. *Comparative analysis of international cases and Hangzhou*

The success of European and American Financial City is mainly due to two aspects. In the *time dimension*, they have improved safety and commercial measures in the early planning stage. In terms of the *institutional dimension*, they have received support from the government and adopted an independent operating model of market incentive mechanism. This not only motivated them to take measures to improve business efficiency, but also unintentionally improved the safety of

underground space. European and American Financial City fully considered safety and commerciality in the early planning, eliminated potential safety hazards and laid the foundation for interconnections. These incentives not only attract more people, but also improve the convenience of social residents; for the government, they guarantee the debt balance and social stability, and for the market, it improves the economic benefits of underground space. Overall, the integrity and sustainable benefits of underground space are improved. The Hong Kong MTR has carried out advanced safety and commercial planning and design to achieve high safety and comfort in the business environment. The government delegates more power to the market, developers have full management rights to attract outstanding merchants. These two cases clearly belong to quadrant II (Fig. 6), and have realized the integrated improvement of safety and commerciality.

In Future Sky City, the excessive intervention of government on safety in the early stage has significantly improved the safety. But excessive intervention on safety will sacrifice commerciality, discourage development companies, and affect the overall benefit. The government has always played a leading role in Future Sky City. This shows that Future Sky City is a typical Government-led model (Fig. 6, quadrant III). Underground planning can improve the overall economic efficiency and safety of underground facilities (Vähäaho, 2014). Future Sky City shows the negative impact of excessive government intervention on commerciality. The government needs to plan ahead in conjunction with market forces to make the pre-planning compatible.

The special feature of Seven Fort Complex lies in the lack of government supervision and intervention in the early stage, leading to the failure of safety. However, non-intervention from government has brought other opportunities. It has introduced more powerful investment partners to ensure a strong capital injection, which has provided guarantee for later safety and commercial improvement. The Montreal government has also undergone a transition from government guidance to market-integrated development (Chen, 2015). This is very similar to the introduction of market and capital investment in Hangzhou Seven Fort Complex. This shows the necessity of integrating the government and the market in both China and international regions.

Seven Fort Complex demonstrates that moderate government intervention and supervision are still necessary, but it is equally important to ensure the effective operation of the market, and encourage the participation of multiple subjects to invest more sufficient funds in safety and commercial improvement. But the failure of Kaohsiung Underground Street warns of the risk of insufficient pre-planning intervention.

5. Discussion and findings

5.1. Urban governance strategies at different stages

The paper finds that projects in different types and environments are applicable to different dimensions and models. It should be determined by the safety risk and the capability of the project. This is a matter of choice between safety first or commerciality first. What behind the choice is actually the logical relationship between the government and the market. The government should assist the market to combine safety and commerciality or make the right choice. Projects with high safety risks require the safety model. Projects with low safety risks and commercial potential should use compatibility models to tap economic benefits. Dialectical thinking should be used in its entirety. It is inappropriate to overemphasize safety and neglect commerciality, at the same time it is not advisable to overemphasize commerciality and neglect safety.

In the early stages of urbanization in developing countries, it is necessary to recognize the coordination between the government and the market in the planning. The supervision of government in early planning has a significant impact on safety, and market forces make up for the lack of government but are limited in terms of safety, both government and market forces are crucial. In the latter stage of urbanization, the supervision and support of social entities are needed. The ratification and resistance of social entities (citizens, residents) of property rights directly affect the planning and the interconnection between spaces, which in turn affects the overall benefits. The government, market, and social entities correspond to different functions. Urban planning requires the cooperation and mutual assistance of the government, market, and society, while space guidance and control require more government policies. The society is better at bottom-up supply and repair, the market is better at the coordination of empowerment, competition and choice.

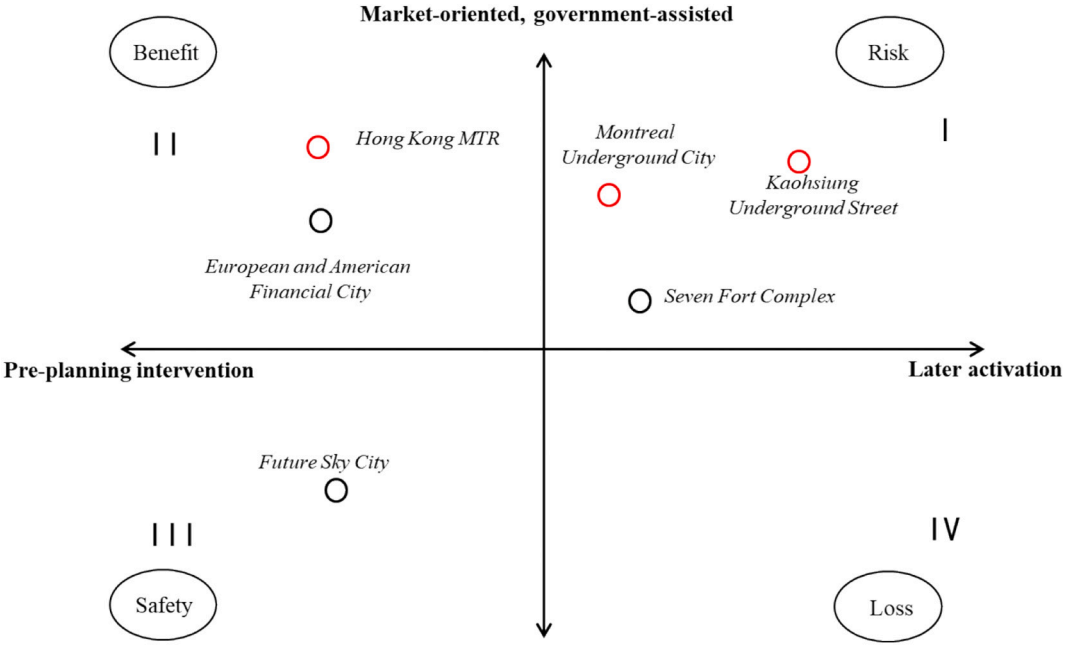

Fig. 6. Complete conceptual framework.

5.2. Innovation in theory and practice

From the perspective of urban planning and governance, the penetration of UUS in various regions is more conducive to achieving the city integrity. The government supports the development of UUS at the macro level, and the market also wishes to develop more space for economic benefits. The cooperation between the government and the market in the preliminary planning is more conducive to the overall connection of UUS in various regions. But the difference is that the government limits the depth and scope of underground development for safety reasons. The government and enterprises have their own responsibilities. The basis for government-enterprise cooperation is to define responsibilities clearly. The government needs to have a clear target, and supervise the short-sighted behavior of the market. At the same time, the government also needs to emancipate the mind, protect the rights and interests of enterprises, and achieve a win-win situation.

This paper attempts to incorporate institution and time dimensions into the theoretical framework of urban governance, and analyzes the role of government and market entities in different dimensions. Coming to a theoretical conclusion: the cooperation between the government and the market can increase the sustainable benefits and integrity of underground space. The market chasing short-term interests will not attach importance to safety construction at an early stage, but this will result in more losses and risks. Governments pursue political stability and attach great importance to safety at an early stage, but excessive intervention will affect commercial viability. Excessive government intervention not only directly affects the promotion of commerciality in planning, it further undermines the enthusiasm of enterprises. Government intervention and market mechanisms need to be balanced.

In terms of practice and policy recommendations, the paper proposes a multiple governance mechanism (Fig. 7) which to integrate safety and commerciality to conform socio-economic benefits. The multiple governance mechanism means that government can only intervene moderately, focusing on supervision rather than regulation, and assist the market mechanism to work effectively. Both the government and the market need to cooperate in pre-planning, introduce diversified market forces to share risks, and give incentives to the market for autonomous operation. According to the maturity of the market environment in different cities, the government and enterprises need to negotiate the proportion of self-holding operating area. In the later stages of urbanization in developing countries, it is necessary to increase the research on how social subjects participate in urban governance, how to stimulate their enthusiasm for participating in planning, and achieve diversified governance and overall planning.

5.3. Future research

In addition to safety and commerciality, future research can also be followed from the perspective of planning efficiency, cost and benefit. The government is cautious in planning, but the efficiency is not enough. Market participation in planning and construction can significantly improve efficiency, but the difficulty lies in judging how much planning autonomy the market needs. From an economic point of view, safety is essentially investment and cost, the higher the security, the higher the cost, while commerciality represents economic benefits. This paper integrates the two from the perspective of government and market governance. But whether there is a balance between costs and benefits in economics is also a point worth pondering.

6. Conclusion

This paper criticizes the traditional planning theory that focuses on the physical level, and proposes the urban governance theory that should focus on the subject level. On the basis of the physical space and function dimensions, the paper focuses on the influence and function of the institution, time dimension and subject governance in planning, and draws a theoretical conclusion: a single government and market planning model is not conducive to sustained benefits, urban governance needs to adjust the absolute power of the government in planning, establish a mechanism for market participation in early planning, increase the self-holding ratio of market operations, and realize the sustainable benefits and integrity. The regret and shortcoming of this paper is that it did not analyze the important influence of society in detail. Therefore, the paper suggests that future governance theoretical research should pay more attention to the influence of society in urban governance.

This paper revealed that the internal relationship for the choice of safety and commerciality is essentially the logic between government and market in terms of planning objectives and resource allocation. The logic behind the choice between safety first and commerciality first in UUS is actually the logical order and relationship between the government and the market. The article concludes that the government and the

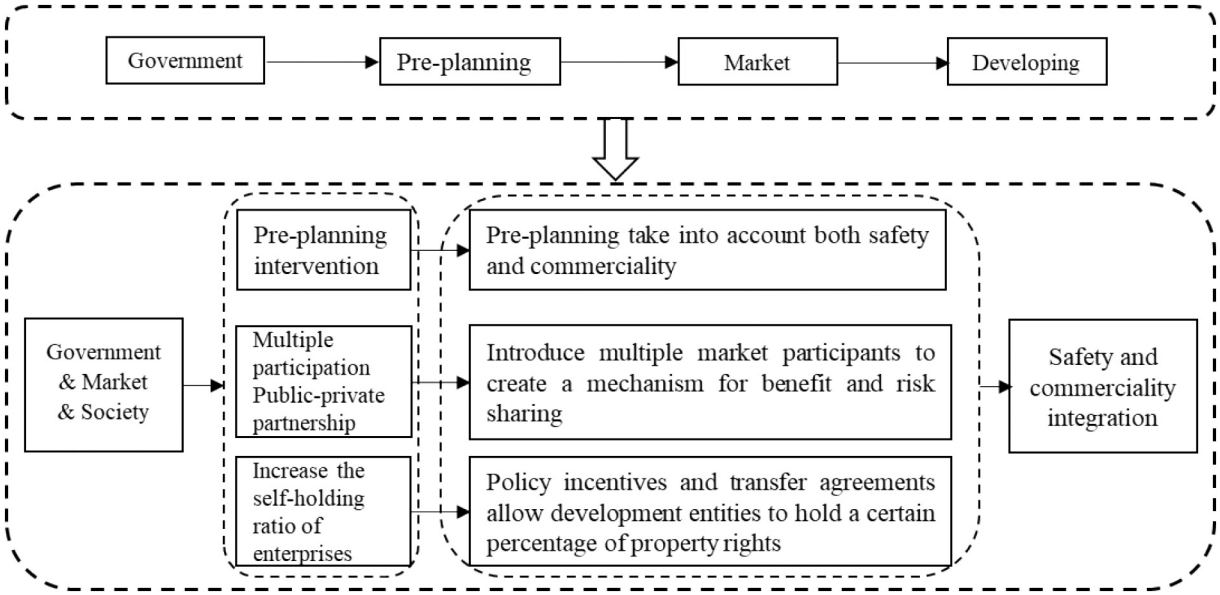

Fig. 7. A multiple governance mechanism.

market should intervene in pre-planning to coordinate safety and commerciality compatibility, and a logical conversion from government-led to market-oriented and government-assisted is required to solve the imbalance of safety and commerciality.

This conclusion supports and affirms the urban governance theory of mutual support between the government and the market. The research shows that the dynamic cooperation and conflict between the government and the market require better communication and coordination. In developing countries, excessive government intervention will make safety and commercial imbalances. For developing countries represented by China, it is necessary to clarify the logical relationship between the government and the market in UUS. The government should assist the market in combining safety and commerciality or make the right choice, evolve from a complete government-led model to a combination of government and market model. The integration of safety and commerciality is a win-win situation for the government, market, society and public. The balance between government intervention and market economy requires more exploration in the future, and the relationship between the government and market needs to be handled properly. It is necessary to transform government functions and decentralize the operational management of UUS to enterprises. At the same time, the synergistic effect and comprehensive partnership between government, market and society need to be constructed.

CRediT authorship contribution statement

I have made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND

I have drafted the work or revised it critically for important intellectual content; AND

I have approved the final version to be published; AND

I agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Interview record with Vanke future sky city project manager

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